Subject: **Integrating IPv6 into Agency Enterprise Architecture Planning**
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1 Background

Internet Protocol Version 6 (IPv6) has been recognized as a critical enabling technology for federal agencies. IPv6 will help ensure that the Internet can support a growing user base and the increasingly large number of IP-enabled devices. IPv6 is replete with new features and functions such as expanded address space, improved flexibility and functionality, improved information routing, enhanced mobility features, simplified activation, configuration and operation of networks and services, and once fully implemented, improved security. IPv6 is a big package, and addressing is only the most visible component of the work. IPv6, when fully functional, will ultimately result in a number of benefits, but more importantly a new communication paradigm.

OMB Memorandum 05-22, "Transition Planning for IPv6" (http://www.whitehouse.gov/omb/memoranda/fy2005/m05-22.pdf), directs agencies to implement the IPv6 protocol within their network backbone by June 2008. In support of this goal, agencies are required to meet a number of interim milestones, including completion of two inventories of IP devices and technologies, completion of an IPv6 transition impact analysis, and development of an IPv6 transition plan. Agencies are required to submit a completed IPv6 transition plan, as well as a progress report on the inventory and impact analysis, as part of their enterprise architecture (EA) assessment in February 2006.

The CIO Council Architecture and Infrastructure Committee (AIC) will be publishing IPv6 implementation guidance in a "chapter" format. This document is the first in a series of four chapters. This document will address the use of EA to plan for enterprise-wide IPv6 transition, as well as specific instructions on the IPv6-related artifacts which need to be included with February 2006 EA submissions. The second chapter will address specific elements of agency transition, such as 1) IPv6 transition planning best practices 2) networking & infrastructure, 3) addressing, 4) information assurance, 5) pilots, testing and demonstrations, 6) applications, 7) standards, and 8) training. The second chapter will be issued in late-December 2005. The third chapter will address governance aspects of IPv6 transition. The fourth chapter will address acquisition and procurement. The publication dates of Chapters 3 and 4 have not yet been finalized. All chapters will be issued to agencies through the AIC.

2 Agency Responsibilities

IPv6 is not merely a technology insertion or network upgrade. It is an enterprise transformation driven by business, environmental, and technology factors, the scope and impact of which extend well beyond the IT organization. Since IPv6 has the potential to

impact agency decisions about business performance, business processes, information, technology infrastructure, security and other strategic initiatives, IPv6 should be incorporated within the agency's strategic planning and enterprise architecture development activities.

To appropriately address the requirements in OMB Memorandum 05-22, related to agencies' enterprise architecture submissions to OMB in February 2006, agencies should:

- ✓ Incorporate IPv6 into their IRM Strategic Plan,
- ✓ Update their enterprise architecture, including:
  - The baseline architecture
  - The target architecture
  - The transition strategy
  - Other enterprise architecture documentation, as necessary,
- ✓ Complete their IPv6 transition plan, and
- ✓ Complete their IPv6 progress report.

Agencies should create a cross-functional team to support IPv6 transition planning and implementation, including representatives from agency lines of business, infrastructure, application development, security, enterprise architecture, capital planning, and procurement. The IPv6 team should remain actively engaged with agency leadership through all phases of the transformation effort.

2.1 IRM Strategic Plan

Implementing IPv6 represents a strategic opportunity for agencies to provide improved services with greater efficiency.

Some of the benefits of transitioning to an IPv6 infrastructure include:

- **A larger address space.** Agencies have the opportunity to network-enable new types of agency assets, such as remote sensors, handheld computing devices, industrial machinery, mobile phones, and other devices with individual and unique IP addresses. This will allow for the elimination of network address translation and enable direct end-to-end connectivity between IP-enabled devices and systems.
- **More robust mechanisms for prioritizing data traffic**. These provide a more reliable infrastructure for bandwidth-intensive applications such as streaming video, voice over IP, near-real-time collaboration and others.
- **Auto-configuration**. Allows devices to automatically configure themselves and join networks without requiring centralized servers to manage them. Mobility support built into IPv6 will enable devices to remain connected even while roaming across great physical distances and multiple networks. These capabilities will enable flexible, decentralized, "plug and play" networking that will decrease administration requirements and provide continuous connectivity.

- **End-to-end security**. IPv6 incorporates (and requires) end-to-end security for all IP traffic directly within the network layer, simplifying and strengthening network security.

The first step to incorporating the benefits of IPv6 into the agency's strategic and EA planning processes should be to incorporate IPv6 as a strategic initiative within the agency's Information Resource Management Strategic Plan. The IRM plan documents the agency's strategic goals for IRM over a multi-year horizon and aligns them to the agency's overall strategic plan as required by OMB Circular A-130 (http://www.whitehouse.gov/omb/circulars/a130/a130trans4.pdf).

In particular, agencies should identify:

- **Strategic drivers for the adoption of IPv6 by the agency**. Agencies should link IPv6 to specific strategic goals and objectives for the agency. For example, IPv6 may advance agency goals associated with expanding electronic government, improving services to citizens, or other goals specific to each agency's mission.
- **How IPv6 could benefit agency lines of business.** Agencies should identify which programs and lines of business will achieve improved performance through IPv6 adoption. Moreover, IPv6 may enable the agency to provide additional services to citizens, businesses, or other organizations.
- **How IPv6 could benefit cross or multi – agency lines of business**. Agencies should identify programs and lines of business which will achieve improved performance or strategic advantage through IPv6 adoption. For example, IPv6 may be a key enabler for improving communications infrastructure for first responders.
- **The impact IPv6 adoption will have** on other enterprise activities such as organizational planning, budgeting, procurement and human resources management
- **Performance objectives** for the IPv6 transition program itself. Creating meaningful performance metrics for IPv6 deployment is a cornerstone of effective transition planning and will enable agency business owners to see the return the IPv6 business case represents.

2.2 Updating the Enterprise Architecture

Per OMB Circular A-130, agencies are required to have three primary elements within their enterprise architectures: a baseline (as-is) architecture, a target (to-be) architecture, and a transition strategy that defines the process of migrating from the baseline to the target architecture. IPv6 should be incorporated into each of these perspectives of the agency enterprise architecture.

The baseline architecture should include IT assets affected by IPv6 transition as per the IP device and technology inventories required by OMB Memorandum 05-22. The target architecture should reflect not only the impact on agency networking components, but should also reflect the impact of IPv6 on other architectural views such as Business,

Strategy and Performance, Data, Service Component, Technology, and Security and Privacy. The agency's IPv6 transition plan should be consistent with the EA transition strategy.

2.2.1 Baseline Architecture

OMB Memorandum 05-22 requires agencies to perform an inventory of their existing IT infrastructure to determine which assets will be affected by the transition of the network backbone to IPv6. The initial inventory to be completed by November 15, 2005 must list networking hardware within the backbone. The second inventory to be completed by June 30, 2006, is much broader and should include not only networking hardware, but applications, operating systems, and other devices impacted by the transition of the network backbone to IPv6.

Agencies should utilize the inventory data to update the current technology and service component views of their baseline architecture, specifically:

- The **Service Component** architectural view should be updated to incorporate IP dependency information for agency IT assets. Assets which depend on IP (but are not IPv6 compliant) can be identified directly from the architecture and prioritized accordingly within the agency's capital planning activities.
- The **Technology** architectural view should be updated to reflect which technology assets within the agency either provide or require IP services, and whether those assets, such as routers and servers, are capable of being upgraded to support IPv6 (.

2.2.2 Target Architecture

IPv6 represents a common technology standard for all federal agencies. As such, it should be incorporated as an element of the agency's target architecture for 2008 and beyond. However, the effect of the transition to IPv6 extends well beyond the selection of agency networking components. The agency's target architecture should reflect the impact of IPv6 within all architectural views, specifically:

- The **Strategy and Performance** architectural view should reflect the fact that IPv6 will represent a strategic change within the agency, as documented in the agency's IRM Strategic Plan. Specifically, the target EA should document:
    - Strategic drivers for the adoption of IPv6 which will include compliance elements such as Memorandum 05-22, but more importantly, business opportunities to improve services and efficiency
    - Changes to the agency's IRM strategic goals and objectives
    - Performance measurement indicators for the IPv6 transition initiative, aligned to the FEA Performance Reference Model
- The **Business** architectural view should be updated to incorporate changes to the agency's business and investment activities resulting from IPv6 adoption, specifically:

    - New or modified lines of business for the agency that will be enabled through IPv6 adoption, including cross-agency initiatives; these agency lines of business should be aligned to the FEA Business Reference Model
    - Dependencies and impacts of IPv6 adoption on agency programs
    - Changes to the agency's IT investment portfolio; this will include not only the IPv6 transition initiative itself, but other investments that will realize new risks, benefits and costs from the transition to IPv6
- The **Data** view may or may not be affected, depending on the scope of the agency's data architecture. Specific issues to consider include:
    - IP address representation. IPv6 addresses differ both in structure and in length from IPv4 addresses. Agencies that currently record IP addresses within data resources may need to modify their data schemas accordingly.
- The **Service Component** view of the architecture should clearly document changes to agency IT services and applications that will result from IPv6 adoption. The target should include:
    - Additional agency IT services that will be enabled through IPv6 adoption
    - Service and application dependencies on specific versions of IP
    - Changes to the agency applications portfolio necessitated by IPv6 adoption
- The **Technology** view of the architecture should be updated to address:
    - Changes to technology standards. IPv6 is not a single published standard but rather a collection of Internet Engineering Task Force specifications, known as Request For Comment (RFC) documents. Agencies should clearly define an IPv6 compliance standard for their agency that may incorporate a subset of RFC features as required.
    - Changes to additional technology infrastructure and standards necessitated by the need for IPv4/IPv6 interoperability, such as translation gateways, tunneling mechanisms and others
    - Changes to technology hardware and software products
    - Changes to the agency networking topology, if the agency technology architecture extends to this level of detail
- **Security and Privacy** may be represented as a cross-cutting concern rather than a separate view of the target architecture. IPv6 deployment within the network backbone may have a substantial impact on the target security architecture, including:
    - Changes to network security standards and configuration as a result of the IPv6 end-to-end security model
    - Changes to IT security policy
    - Privacy considerations

2.2.3 Transition Strategy

OMB Memorandum 05-22 requires agencies to develop an IPv6 transition plan, and provide the completed plan as part of the February 2006 EA assessment submission to OMB. Although agencies are expected to develop a detailed IPv6 transition plan as part of their regular project management activities, agencies do not need to include this particular document as part of their February 2006 EA assessment.

Rather, OMB will be reviewing agency EA Transition Strategies in order to gauge progress towards the June 30, 2008 deadline. Agencies should submit their EA Transition Strategy document as part of the February 2006 EA assessment. Agency EA Transition Strategies should reflect IPv6 key activities, timelines, milestones, and dependencies.

IPv6 will require careful attention to several specific transition strategy analysis activities, including:

- **Detailed dependency analysis and sequence planning.** Dependency on a specific version of IP may be widespread and require research and testing on the part of agencies. The successful transition of an IT service to be IPv6-capable includes not only the networking hardware, but might also include workstation and server operating systems, applications, and peripheral devices. These "ripple effects" must be effectively documented within the agency target architecture if the transition is to succeed. This analysis is a critical input to the development of a sequencing plan that organizes all of the major elements of IPv6 deployment as subprojects within the larger initiative.
- **Interrelationships with other infrastructure programs.** The adoption of IPv6 within the agency network backbone is a major initiative that will have far-reaching consequences for agency EA transition planning. IPv6 adoption should not be treated as an isolated initiative, but should be carefully coordinated with other agency modernization initiatives, such as lines of business outsourcing, HSPD-12, COOP, and RFID,
- **Ensuring the transition strategy drives IT investment decisions.** Agencies should use their transition strategy as a basis for making future IT investment decisions, including ensuring IT investments appropriately address agency IPv6 requirements.
- **Establishment of quarterly performance milestones.** The transition strategy should incorporate specific quarterly performance milestones for IPv6 adoption. These may include elements such as address allocation, hardware deployment, and the completion of user training. Problems with IPv6 adoption can then be identified early in the transition so managers can make course corrections and develop risk mitigation strategies as appropriate.

Agencies should refer to the OMB EA Assessment Framework Version 2.0 (to be issued in November 2005) for more detailed information on the components of an effective EA Transition Strategy.

The CIO Council will be publishing additional guidance in the coming months to assist agencies with IPv6 transition planning. This guidance will address key transition elements such as infrastructure and networking, applications, information assurance, testing, and training. To begin development of IPv6 transition plans prior to the issuance of this guidance, agencies should use the activities listed in Attachment C of OMB Memorandum 05-22 as the foundation for these plans. Agencies may also reference the Department of Defense IPv6 Transition Plan (FOUO), available upon request by the agency IPv6 lead to ipv6@omb.eop.gov.

2.2.4 Other EA Documentation

With the release of the OMB EA Assessment Framework Version 2.0, OMB will evaluate whether and how the EA is actually being used within the agency to achieve results. As a result, the revised Framework incorporates a number of new assessment criteria to evaluate agency performance. There are specific policy-alignment criteria for IPv6, which clearly identify the documentation and activities required to achieve a specific maturity level. However, IPv6 adoption will also play a substantive role in assessing agency maturity levels for several other assessment criteria, namely:

- **EA Governance and Management**: Governance is the mechanism by which EA planning decisions are realized and enforced within the agency. Therefore, agencies should be prepared to provide governance charters, agendas, minutes and other documentation to demonstrate that:
    - The agency body responsible for EA governance is aware of the requirement for IPv6 transition and the specific role IPv6 plays within the agency's target architecture;
    - The agency body charged with implementing IPv6 is coordinating its activities with the EA governing body, and changes to either EA or IPv6 implementation policies are effectively communicated to each group;
    - The EA provides agency managers with the ability to observe the current state of the IPv6 transition within the agency and its impact on other strategic agency initiatives
- **CPIC Integration:** The EA should drive the selection, control and evaluation of agency investments and other capital planning activities. To achieve this goal, agencies should be prepared to provide evidence through their CPIC guides, business cases and investment review board minutes that:
    - IPv6 compliance is clearly established as a requirement within the agency's procurement and investment review guidelines
    - The agency EA is capable of reporting which agency investments are included in the IPv6 implementation within the agency network backbone
- **Business Driven:** Agencies should be able to clearly establish a line of sight between the agency's strategic planning activities and the IPv6 implementation , specifically:
    - IPv6 transition planning is clearly identified as a major initiative within the agency's EA Program Plan;

    - The strategic drivers supporting IPv6 adoption identified within the agency IRM Strategic Plan are clearly documented within the agency's target strategy and performance view
    - Performance measures associated with IPv6 implementation are clearly documented within the agency's target strategy and performance view and are organized using appropriate measurement indicators identified within the FEA Performance Reference Model
- **Business Process and Service Improvement:** Agencies should leverage the analysis they performed as part of the IRM Strategic Plan to document the business benefits they expect to achieve through IPv6 implementation, specifically:
    - Agency lines of business that are expected to attain service improvement or cost savings as a result of IPv6 implementation
    - New or modified lines of business and agency programs enabled through IPv6 technologies
    - Expected impact on agency programs as a result of IPv6 implementation
- **IT Implementation Improvement:** Agencies should be able to demonstrate that their IPv6 transition strategy is directly integrated into their methodology for implementing agency IT projects. Specific evidence should include:
    - Guidance to IT projects (whether custom-developed or COTS) identifying specific technical requirements for IPv6 compliance
    - Documenting the impact of IPv6 adoption on the agency's plans to establish a service-oriented architecture infrastructure

2.3 IPv6 Progress Report

The IPv6 progress report should include the following:

- ✓ Status of the second IP devices and technologies inventory (Attachment A of OMB Memorandum 05-22),
- ✓ Status of the IPv6 impact analysis (Attachment B of OMB Memorandum 05-22), and
- ✓ Overall agency progress towards June 30, 2008 IPv6 transition target date

Agencies should include interim milestones and dates in the progress report for both the June 30, 2006 and June 30, 2008 deadlines specified by OMB Memorandum 05-22. These milestones should align with those included in the agency IPv6 transition plan and EA transition strategy.

Agencies should also include any challenges, issues, or risks they are facing with completion of the second inventory, impact analysis, or other aspects of the agency's transition to IPv6.

Subsequent to the February 2006 EA assessment, OMB will continue to monitor the progress of agency IPv6 efforts through the standard, quarterly EA assessments. The

OMB Enterprise Architecture Assessment Framework Version 2.0, and the agency EA Transition Strategy, will be used to assess agency progress.

3 Submission to OMB

Agencies should provide the following information to the FEA PMO (via email at fea@omb.eop.gov) as a part of their standard February 28, 2006 EA submission:

- Your EA Assessment using Version 2.0 of the OMB Enterprise Architecture Assessment Framework,
- A complete inventory listing of all EA documentation used to complete the February 28, 2005 Assessment,
- A copy of all your agency's current EA program documents and artifacts, including a copy of the IRM Strategic Plan and EA Transition Strategy, and
- A copy of your agency's IPv6 progress report

4 Contacts

For further information regarding the Federal Government's transition to IPv6 or this guidance, please contact Lew Oleinick (202-395-7188; oleinick@omb.eop.gov)